DRAFT ETMS System Requirements

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Date:	May 15, 2002
Requirements Described:	Smoothing Sector Alert Reporting
Document Version:	2.1

1.0 Scope

This is the system requirements document for the modified functionality of Sector Alerts for release 7.5. This addresses the modifications needed to prevent the Traffic Situation Display (TSD) from switching sector alerts on and off too rapidly.

2.0 Background

The Monitor Alert (MA) function of the Enhanced Traffic Management System (ETMS) alerts traffic managers to potential traffic overloads in National Airspace System (NAS). The results of this analysis are a graphic display on the TSD that shows when the potential capacities of a NAS component exceed a stated threshold. The monitored components (or elements) are selected airports, fixes and sectors.

The ETMS Traffic Database (TDB) subsystem counts on a minute-by-minute basis, all the aircraft that are or will be impacting the monitored elements. For airports, these are flights arriving or departing during the minute; for fixes, the flights that will cross the point; and for sectors, all the flights that will traverse the sector's airspace.

The information is collated into fifteen-minute intervals with the number of flights impacting the interval being reported as the count. If the greatest number of flights in any one-minute of the fifteen-minute interval exceeds the stated threshold, the interval is said to be alerted. If the number of active flights alone exceeds the threshold, it is considered to be alerted "red." If the combination of active and proposed flights exceeds the threshold, it is considered "yellow." Otherwise, the interval is considered to be "green."

The TDB computes the fifteen-minute counts and determines intervals and the sector elements" colors on a scheduled basis. The current schedule generates and distributes the information every minute. The report of alerted elements is prepared for period of time as configured.

The TDB forwards the collection of elements to the Alert Server Processor (ASP) who arranges for all the TSDs downstream to receive the collection of elements. The TSD screens (if so configured) will then display the "red" and "yellow" components.

The necessity to improve functionality is a result of the changing the distribution from once every five minutes to once a minute. This causes sectors to flash between colors at a disconcerting rate. As an extreme example, a sector can be serially red, green, yellow, green and red again within five minutes. This reduces credibility and raises questions about the quality of the Monitor Alert product.

Note that these requirements address only sectors since the nature of airports and fixes, as points, lack the dynamics of timing caused by the variety of geometries and overlaps that constitute sectors.

The existing Monitor Alerts functionality (before ETMS release 7.5) uses one alert capacity to set an alerted state. This is based upon the concept of a peak flight number, defined as, the maximum value of all of the one minute counts that constitute the fifteen minute interval. When the peak flight number in the interval is greater than the alert capacity, the sector alert is turned on. When the peak flight number in the interval is the same or smaller than the alert capacity, the sector alert is turned off.

3.0 Functional Requirements

The proposed algorithm change is to use two threshold values instead of one. The first value is the "turn alert on threshold." The second value is the "turn alert off threshold." A sector will be turned onto an alert state ("red" or "yellow") only when the peak minute value exceeds "the turn alert on threshold." A sector will only be switched from an alert state ("red/yellow" to "green") when the peak minute value is less than "the turn alert off threshold."

The "turn alert on threshold" will be named "on threshold" in the following requirements. The "turn alert off threshold" will be named "off threshold" in the following requirements.

Sector Threshold Initialization

1) **The TDB shall read in one or two threshold values for each monitored sector.**
   a) **The first value shall be the "on threshold"**
   b) **The second value shall be the "off threshold"**
   c) **If only one value is read, it shall be used as both the on and off thresholds.**

2) **The TDB shall sense when an "on threshold" is greater than the maximum valid value (255)** (the maximum value that the TDB can handle)
   a) **The TDB shall report the discrepancy by its normal exception reporting methods**
   b) **The TDB shall set the "on threshold" to be 255**

3) **The TDB shall sense when a sector's "off threshold" is greater than the sector's "on threshold"**
   a) **The TDB shall report the discrepancy by its normal exception reporting methods**
   b) **The TDB shall set the "off threshold" to be same value as the "on threshold"**

4) **The TDB shall sense when a sector's "off threshold" is less than the minimum valid value (1)**
   a) **The TDB shall report the discrepancy by its normal exception reporting methods**

b) The TDB shall set the "off threshold" to be 1

5) The TDB shall sense when a sector's "on threshold" or "off threshold" is less than 1
- **a) The TDB shall report the discrepancy by its normal exception reporting methods**
- **b) The TDB shall set the "on threshold" or "off threshold" to be 1**

6) The default threshold value for sectors will remain unchanged by this work.

Sector Threshold Processing

7) The TDB shall compute the peak minute value for each interval

8) If the peak minute value is higher than the "on threshold," the TDB shall declare the interval to be in an alert state
- **a) The TDB shall set the interval to the correct alert color ("red" or "yellow")**
- **b) The TDB shall set the element color to the correct color**
- **c) The TDB shall save the interval's alert status for the next scheduled cycle**

9) If the peak minute value is between the "on threshold" and the "off threshold"
- **a) The TDB shall set the interval alert status to be the previous cycle's status**
- **b) The TDB shall set the element's color to the correct color**

10) If the peak minute value is less than the "off threshold"
- **a) The TDB shall set the interval color to be non alert ("green")**
- **b) The TDB shall set the element color to non alert ("green") unless:**
  - **i) Any peak minute on another interval set it to alert status ("on threshold" exceeded)**
  - **ii) Any peak minute on another interval set it to an alert status based upon being between "on threshold" and "off threshold"**
- **c) The TDB shall save the interval alert status for the next scheduled cycle**

Alert report file format

11) The sector alert report file tms will add two new fields for alert off threshold values and unique flight count and active flight count. The data structure count_rec_t is updated as following:

```
typedef struct count_rec_t
   {
     char     nominal_cap,
              nominal_cap_off,        /* new value for default sector alert off threshold */
              today_cap,
              today_cap_off,          /* new value for today sector alert off threshold */
              nominal_ga,
              today_ga,
              ga_count,
              alert_status;
     INT32    scheduled_count,
              active_count,
              total_count,
```

```
        flight_count,          /* unused field, now will contain count of unique flights
                                  during the interval */
        flight_active_count;   /* new value for unique active flight count */
} count_rec_t;
```

A note about the count values: The "scheduled_count," "active_count," and "total_count" will continue to have their current meaning – for sectors these will be the peak instantaneous count for the busiest minute during the interval, and for airports and fixes these will be the cumulative total count for the interval. The new "flight_count" and "flight_active_count" fields will only be meaningful in sector predictions, and they will contain the a count of the total number of unique aircraft expected to be in the sector during the interval *for example, ETMS might predict a sector will have 10 flights in the sector during its busiest minute (the "total_count"), but predict there will be 16 different aircraft in the sector at some point during the 15 minute interval (the new "flight_count" value).*

12) The Airport and Fix alert report files (tma, tmf) are use the same data structure as sector. The fields nominal_cap_off and today_cap_off are not used for Airport and Fix alert reports. The nominal_cap_off will be defaulted to same value as nominal_cap and today_cap_off will be defaulted to same value as today_cap.

13) The tma, tmf, and tms files produced by the TDB are combined into on "tmd" file by the ASP process. The "tmd" files shall have the same strucure as detailed above for the "tms" files.

14) The TSD process receives the "tmd" files and will process the new format.

15) The software dump_traffic is modified to add the two new values nominal_cap_off and today_cap_off for sector alert. The Airport and Fix alert reports will remain unchanged.

TSD Interface Requirements

16) The TSD shall modify the CAPS command when sending sector capacities to send the new "on threshold" and "off threshold" to the TDB

- **a) Airport and Fix CAPS commands will remain unchanged from their current format.**
- **b) Modify sector CAPs commands. The new sector CAPS command should be able to set alert on and off thresholds at same time or only set one of the thresholds.**
  - **i) When set both on and off thresholds at same time. The command format should look like:**
    - **SCAP S <sector name> ON <on threshold> OFF <off threshold> <date> <Time from> <time to>**
  - **ii) The new CAPS command should be able to set on or off threshold only. The command format for setting any one value should look like:**
    - **SCAP S <sector name> ON <on threshold> <date> <Time from> <time to> ---- set on threshold**
    - **SCAP S <sector name> OFF <off threshold> <date> <Time from> <time to> ---- set off threshold.**

17) The format of the TDB's response to the CAPL command will change slightly to list the new "on" and "off" values. The TSD should just display the response as it does now.

18) TSD should display both alert on threshold and off threshold on Alert TimeLine Dialog and Bar Chart for sectors (airports and fixes would remain unchanged).

19) The TDB shall accept CAPS command from the TSD

- **a) The TDB shall validate the values within the CAPS command**
  - **i) The sending site shall be verified as to whether it is allowed to change this sector's values (as is done currently).**
  - **ii) The "on threshold" shall be validated**
  - **iii) The "off threshold" shall be validated**
  - **iv) If "on threshold" or "off threshold" is greater than the maximum valid value or smaller than the minimum valid value, TDB shall send an error message to TSD**
- b) **The TDB shall send an acknowledgment back to the TSD on a valid message to the extent that it currently responds to a CAPS command.**

4.0 Performance Requirements

1) The additional processing overhead of these requirements shall not increase the time to create the TDB sector file by greater than 10%.

5.0 ISSUES

5.1 *These requirements implement one algorithm. If the behavior of the Monitor Alert color changes on the TSD is not perceived to be an improvement, these requirements would need to be re-addressed.*

5.2 The "off threshold" cannot be greater than "on threshold" at any time.

6.0 Assumptions

N/A